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Flexible Radiation codes for Numerical Weather Prediction Across Space and Time Scales

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LONG-TERM GOALS

We seek to develop radiation parameterizations for dynamical models that are computationally efficient and work seamlessly across models at all time and space scales, especially from regional models to global models.

OBJECTIVES

We intend to build radiation codes for use in the Navy's limited area model (COAMPS) and global model (NOGAPS/NAVGEM). The codes will be scale-aware, computationally efficient across a range of computer architectures, and operate continuoulsy rather than at discrete time steps.

APPROACH

We are building on two algorithms developed by the PI: Monte Carlo Spectral integration (Pincus and Stevens, 2009) for time continuity and the Monte Carlo Independent Pixel Approximation (Pincus et al., 2003) for sampling sub-grid-scale variability in cloud optical properties.

WORK COMPLETED

We have nearly completed initial development of these codes, which are highly modular. Gas optics come from the state-of-the-art RRTMG radiation parameterization. Cloud optics use lookup tables developed at the Max Planck Institute for Meteorology (Hamburg) though other parameterizations are possible. We have written vectorized longwave (emission/absorption) and shortwave (mutliple scattering) solvers and higher-level drivers. We have developed a general method for enapsulating the spectral sampling strategy used by MCSI, including the possibility of using one or more "teams" of spectral points to limit the maximum error realized. We are exploring methods for more accurate and efficient diagnosis of cloud radiative effects.

RESULTS

We are still in the software development and optimization phase.

IMPACT/APPLICATIONS

Once we have reasonably efficient baseline codes we will move to introduce them into Navy forecasting models.

RELATED PROJECTS

NONE at the present time

REFERENCES

Pincus, R. and B. Stevens, 2009: Monte Carlo Spectral Integration: a consistent approximation for radiative transfer in large eddy simulations. *J. Adv. Model Earth Syst.*, **1,** 9. doi:10.3894/JAMES.2009.1.1

Pincus, R., H. W. Barker, and J. J. Morcrette, 2003: A fast, flexible, approximate technique for computing radiative transfer in inhomogeneous cloud fields. *J. Geophys. Res. - Atmos.*, **108**. doi:10.1029/2002jd003322

PUBLICATIONS

Pincus, R., 2011. Radiation: Fast physics with slow consequences in an uncertain atmosphere. In *Proceedings of the ECMWF/WGNE/THORPEX Workshop in Representing Model Uncertainty and Error in Weather and Climate Prediction*, forthcoming from ECMWF.